DOE/EH-0486

Integrating Safety and Health During Deactivation

With Lessons Learned From PUREX

September 29, 1995

U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Environment, Safety and Health
Office of the Deputy Assistant Secretary for Worker Health and Safety

DOE/EH-0486

Integrating Safety and Health During Deactivation

With Lessons Learned From PUREX

September 29, 1995

U. S. DEPARTMENT OF ENERGY
Assistant Secretary for Environment, Safety and Health
Office of the Deputy Assistant Secretary for Worker Health and Safety
Washington, DC 20585

Comments, suggestions or other related information are welcomed for consideration and possible incorporation into future iterations of this report. Please send any such correspondence to:

Check (Tony) C. Eng, P. E.
Department of Energy
Office of Worker Health and Safety
19901 Germantown Road
Germantown, MD 20874-1290

Telephone: 301-903-4210
Fax: 301-903-8817
Internet: tony.eng@hq.doe.gov

Foreword

This report summarizes an integrated safety and health approach used during facility deactivation activities at the Department of Energy (DOE) Plutonium-Uranium Extraction (PUREX) Facility in Hanford, Washington. Resulting safety and health improvements and the potential, complex-wide application of this approach are discussed in this report through a description of its components and the impacts, or lessons-learned, of its use during the PUREX deactivation project. As a means of developing and implementing the integrated safety and health approach, the PUREX technical partnership was established in 1993 among the Office of Environment, Safety and Health's Office of Worker Health and Safety (EH-5); the Office of Environmental Management's Offices of Nuclear Material and Facility Stabilization (EM-60) and Compliance and Program Coordination (EM-20); the DOE Richland Operations Office; and the Westinghouse Hanford Company.

DOE and DOE contractor project managers, safety and health professionals, engineers and workers who are responsible for the planning, management and execution of deactivation activities should glean important safety and health insights from the PUREX deactivation project. These insights have demonstrated the importance, cost-effectiveness and practicability of integrating safety and health elements into all phases of deactivation project planning and work.

We believe that this report will provide guidance for instituting an integrated safety and health approach not only for deactivation activities, but for decommissioning and other clean-up activities as well. Our confidence is based largely upon the rationality of the approach, often termed as common sense, and the measurable safety and health and project performance results that application of the approach produced during actual deactivation work at the PUREX Facility.

Therefore, to help ensure that safety and health are priorities to be efficiently improved upon and maintained during all work-related activities, we encourage DOE and DOE contractor management and staff to incorporate the safety and health insights described in this report as part of their work planning and execution activities.❑

Joseph E. Fitzgerald Jr.
Deputy Assistant Secretary for
Worker Health and Safety (EH-5)

Willis W. Bixby
Deputy Assistant Secretary for
Nuclear Material and Facility Stabilization (EM-60)

Randal Scott
Deputy Assistant Secretary for
Compliance and Program Coordination (EM-20)

Lloyd L. Piper, II
Assistant Manager for Facility Transition
Richland Operations Office (RL)

Douglas D. Hamrick
Director, PUREX/UO_3 Transition Project
Westinghouse Hanford Company (WHC)

Contents

Definitions

Deactivation: The process of placing a facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance program that is protective of workers, the public, and the environment until decommissioning is complete. Actions include the removal of fuel, draining and/or de-energizing of non-essential systems, removal of stored radioactive and hazardous materials and related actions. As the bridge between operations and decommissioning, based upon facility-specific considerations and final disposition plans, deactivation can accomplish operations-like activities such as final process runs, and also decontamination activities aimed at placing the facility in a safe and stable condition.[1]

Decommissioning: Takes place after deactivation and includes surveillance and maintenance, decontamination, and/or dismantlement. These actions are taken at the end of the life of the facility to retire it from service with adequate regard for the health and safety of workers and the public and protection of the environment. The ultimate goal of decommissioning is unrestricted release or restricted use of the site.[1]

Decontamination: The removal or reduction of radioactive or hazardous contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning or other techniques to achieve a stated objective or end condition[1].

Dismantlement: The disassembly or demolition and removal of any structure, system, or component during decommissioning and satisfactory interim or long-term disposal of the residue from all or portions of the facility.[1]

End-Point Criteria: The defined objective(s) or goal(s) that represent the agreed upon facility condition to be achieved at the completion of the deactivation phase.

Facilities: Buildings and other structures, their functional systems and equipment, and other fixed systems and equipment installed therein; outside plant, including site development features such as landscaping, roads, walks, and parking areas; outside lighting and communication systems; central utility plants; utilities supply and distribution systems; and other physical plant features[1].

Failure Mode and Effects Analysis (FMEA): A reliability analysis used to determine how long a piece of complex equipment will operate satisfactorily and to determine what the effects of any failure of individual components might be.[2]

Graded Approach: A process that assures safety analysis and documentation preparation is commensurate with the magnitude of the hazards being addressed and the complexity of the facility and/or systems being relied on to maintain an acceptable level of risk.

Health and Safety Plan (HASP): An Occupational Safety and Health Administration (OSHA) requirement that requires employers to document their health and safety program as it applies to a specific hazardous waste site cleanup. Among other things, it must also contain a work plan

[1] U.S. Department of Energy Office of Environmental Management, "Decommissioning Resource Manual," August 1995, page 3-3

[2] Hammer, Willie, Occupational Safety Management and Engineering, 4th edition, 1989, Prentice Hall, New Jersey, p.p.s. 555-556

which details how work is to be conducted on the site, procedures for safety and health, and a description of the hazards (and their controls) found on the site.

Hazard: A source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel, or damage to a facility or the environment without regard for the likelihood or credibility of accident scenarios or consequence mitigation.

Hazards Checklist: A technique/tool that is used to evaluate the type, and perceived severity of hazards that may be present for a given activity or work task. Common hazards are listed as criteria or questions, as well as hazard characteristics and experience related to the activity. These form the basis of the checklist. The checklist is used to help determine the technique and level of effort for future task-based hazard analyses.

Hazard and Operability Study (HAZOP): Structured reviews of a process to determine the response of systems to deviations from design parameters. The technique uses guide words such as NO or NOT, MORE, LESS, AS WELL AS, PART OF, REVERSE and OTHER THAN. These words are coupled to design parameters, such as temperature, pressure and valve position to describe deviations.

Job Hazard Analysis: An analysis of procedurally controlled activities that uses developed procedures as a guide to address and consider the hazards due to any exposures present during implementation of (job) procedures, the use and possible misuse of tools and other support equipment required by the procedures, and the behavioral motivations of the people performing them.

Preliminary Hazard Analysis (PHA): An initial study from which analysis efforts can be expanded further. It is fairly broad in scope, investigates what hazards might be present, whether they can be eliminated entirely, or controlled. If the hazard cannot be eliminated, the analyst determines whether there are standards or methods by which the hazard could/should, or must be controlled. A review is made of the functions to be performed and whether the environments in which they must be performed will have any adverse effects on personnel, equipment, facilities, or operations.[3]

Safety Analysis Report (SAR): A report that documents the adequacy of safety analyses for a nuclear/non-nuclear facility to ensure that the facility can be constructed, operated, maintained, shut down and decommissioned safely and is in compliance with applicable laws and regulations.

Safety and Health: As defined in this report, a conditional state in which both the public and workers are free from harm. It is also defined as the practice and application of techniques to help prevent illness, injury, death and property loss as a result of unintentional and undesirable conditions and acts.

Safety Authorization Basis: The combination of information relating to the control of hazards at a facility (including design, engineering analyses, and administrative controls) upon which DOE depends for its conclusion that activities at the facility can be conducted safely.

Safety-Critical Items: Equipment, systems, or components that are necessary to prevent or mitigate the harmful consequences of hazardous materials release.

3 Hammer, Willie, Occupational Safety Management and Engineering, 4th edition, 1989, Prentice Hall, New Jersey, p.p.s. 552-553

Standards: As defined by the Department's Standards Committee, standards include "Federal, state, and local laws and regulations; Department Orders; nationally and internationally recognized standards; and other documents (such as industrial standards) that protect the environment and the safety and health of our workers and the public."

Surveillance and Maintenance (S&M): A program established during deactivation and continuing until phased out during decommissioning to provide containment of contamination, physical safety and security controls and maintenance of the facility in a cost-effective manner that is protective of workers, the public and the environment.[4]

Task-Based Hazard Analysis: An approach that focuses the hazard analysis process for work tasks, using a Job Hazard Analysis (JHA), Hazards Checklist, HAZOP, FMEA or other techniques that are appropriate based on task complexity and hazards.

Unreviewed Safety Question (USQ): A process to allow contractors to make physical and procedural changes and to conduct tests and experiments without prior DOE approval as long as the changes do not explicitly or implicitly affect the safety authorization basis of the facility. It also requires that issues with a potential impact to the safety authorization basis be brought to the attention of DOE.

USQ Screening Process: A technique/tool that uses a checklist approach to help determine if suggested changes require a full USQ determination of any effect on the safety authorization basis of the facility.

Work Task: A discrete activity made up of procedures performed in steps to achieve an objective goal such as removal of plutonium from gloveboxes, removal of a chemical from a storage area or removal of asbestos from a facility area.

---

4 U.S. Department of Energy Office of Environmental Management, "Decommissioning Resource Manual," August 1995, page 3-4

Executive Summary

As a result of the shift away from weapons production and research, the Department of Energy (DOE) has thousands of aging surplus facilities that require disposition. This process begins with facility deactivation. However, because many of these facilities are old and house varying quantities of hazardous materials, they pose significant safety and health concerns. As a result, the Office of Worker Health and Safety (EH-5) established a technical partnership with the Office of Nuclear Material and Facility Stabilization (EM-60), the Office of Compliance and Program Coordination (EM-20), the Richland Operations Office (RL), and the Westinghouse Hanford Company (WHC) in order to specifically address these concerns. The technical partnership has been working since 1993 to ensure cost-effective and safe deactivation of the Plutonium-Uranium Extraction (PUREX) Facility at Hanford, Washington. This effort produced important insights and useful practices for integrating safety and health into deactivation work planning and execution at PUREX. The result has been reductions in project costs and baseline schedule, as well as improvements in health and safety at PUREX.

Because this approach is holistic and comprehensive, these safety and health practices can be applied to any deactivation activity, independent of the facility type or hazard. They are also applicable to other cleanup activities such as facility decommissioning (e.g., decontamination and dismantlement) and site remediation. The major safety and health practices are summarized as follows:

- a graded approach to hazard analysis;
- involvement of safety and health personnel in project planning, engineering and execution; and
- use of multi-disciplinary project teams with worker participation.

Graded Approach to Hazard Analysis

Hazard analysis provides the fundamental information to help determine the breadth and depth of safety and health activities, such as radiation protection, exposure assessment, medical surveillance and emergency response. Because deactivation projects vary in their complexity and can potentially involve a wide variety of hazards, the activities necessary to recognize, evaluate, communicate and control hazards must be tailored to address the specifics of the deactivation work, hazard type and hazard severity level. This can be achieved through two important hazard analysis activities: a preliminary hazard analysis and a task-based hazard analysis.

Preliminary Hazard Analysis. The preliminary hazard analysis is the initial step in assessing deactivation project hazards. Performance of this activity can reduce project costs by providing important hazards information required for several activities. These include: planning and scheduling of deactivation tasks; determination of applicable environmental, safety and health standards; assessment of engineering and technology options; establishment of hazard controls; and evaluation of potential safety basis documentation impacts including necessary upgrades and opportunities for integration of various safety documents (e.g., safety analysis and health and safety plans).

The level of effort required to conduct a preliminary hazard analysis is dependent upon the condition of the facility, the availability and quality of facility records and safety documentation and the hazards remaining in the facility. This analysis will require reviews of facility records, the performance of a physical survey of the facility and an evaluation of results.

Task-Based Hazard Analysis. Because deactivation can consist of many one-time and repetitive work tasks, a task-based hazard analysis should be conducted to determine potential preventive and protective measures needed for each type of work task. This analysis can be graded because work tasks vary in complexity and associated hazards.

A graded approach can be accomplished through a hazard screening process, which helps determine the hazard analysis techniques most appropriate for the work task. The hazard screening should result in one of the following options:

- a simple hazard analysis such as a hazard checklist, or a review of the job steps by a few key personnel and workers if the task to be performed is well understood (such as a task based on previously conducted routine maintenance-type activity);
- a more in-depth hazard analysis such as a job hazard analysis if the task is new, major changes in existing procedures have been made, or procedures are to be performed in a new environment; and
- a more thorough systems-type hazard analysis such as a Failure Mode and Effects Analysis or Hazard and Operability Study if the task is perceived to be hazardous and complex.

Involvement of Safety and Health Personnel in Project Planning, Engineering, and Execution

Input from safety and health professionals in project planning, engineering and execution will help ensure that hazards are identified, prevented and controlled in a cost-effective manner. Potential benefits include avoidance of costly project overruns due to project upsets and stoppages; avoidance of retrofits to safety documentation and procedures; selection of work methods and technologies that have minimal adverse impact to safety and health; and assurance that unforeseen hazardous conditions will be identified and addressed in a timely manner.

Safety and Health During Planning and Engineering. Several key activities should be performed to promote safety and health integration during planning and engineering activities. These include: development of necessary interfaces among the various safety and health disciplines and other project personnel; involvement of safety and health personnel in developing project end-point criteria and necessary project work tasks; safety, health and worker input on the selection of engineering technologies to be used in deactivation; and the identification of the DOE and external safety and health standards that apply.

Safety and Health Personnel Involvement During Project Execution. During the execution of project tasks, the primary safety and health emphasis should be on monitoring the adequacy of hazard controls and work practices, and establishing a mechanism for capturing feedback from workers about changes in the condition of the work environment, unforeseen hazardous conditions, inadequate work procedures, or other concerns. Important monitoring mechanisms that should be incorporated into the deactivation effort include activities such as periodic walkdowns of the facility, daily pre-job meetings and worker involvement in procedure reviews and worksite inspections. Also, the Unreviewed Safety Question Process (USQ) is an important activity for assessing the impacts that facility changes may have on original safety basis assumptions

Use of Multi-disciplinary Project Teams with Worker Participation

Multi-disciplinary project teams that include safety and health professionals, engineers, occupational medical practitioners, worker representatives and management can help to improve overall safety and health performance. Establishing such teams in the initial stages of planning will enhance communication among project personnel, reduce possible duplications of project activities, and help integrate the identification and evaluation of all major hazards. Project teams or subsets of these teams should be used to identify deactivation work tasks, develop project schedule, evaluate hazards and recommend hazard controls, prepare project safety documentation and identify applicable safety and health standards.

Involving workers on the team provides a mechanism for incorporating worker experience and knowledge of the facility and operations history. As a result of their daily hands-on experience, workers may have valuable information on how best to prevent or minimize hazards. Also, at some DOE surplus facilities, the worker's institutional knowledge of facility operations may be the only record of the changes made at the facility. ❑

1.0 Introduction

1.1 Background on Deactivation as a Major DOE Mission

A decline in the production of nuclear weapons has reduced the need for a number of DOE facilities. As a result, many facilities have been shutdown after decades of operation. In a recent survey led by the Office of Nuclear Material and Facility Stabilization (EM-60), the Surplus Facility Inventory and Assessment (SFIA) Project identified some 779 surplus contaminated assets[5]. An additional 640 contaminated assets are likely to be classified as surplus by the next decade (404 assets before 1999). Another 3,271 assets have been identified as "potentially surplus," requiring further review.

Many of these surplus assets, or facilities, are not only contaminated with radioactive and hazardous materials, but are also degraded requiring immediate attention. Additionally, many aged facilities do not meet today's safety standards. Due to limited resources, the Department faces extraordinary challenges relative to the disposition of its inactive surplus facilities.

> Deactivation is currently not included in the policy for decommissioning DOE facilities under CERCLA.

Deactivation is a major component of dispositioning these facilities. The mission of deactivation is to place a facility in a safe and stable condition to reduce the long-term cost of surveillance and maintenance activities which are necessary until decommissioning is feasible. Deactivation may include activities such as the removal of surplus fuel, stored radioactive and hazardous materials, and the removal or consolidation of support systems, such as electrical circuits and ventilation systems.

[5] An asset, as defined in the SFIA Project, is a "building/structure or a stand-alone tank." Contaminated is defined as having the "presence of a foreign substance which poses a safety, health, environmental, or regulatory concern."

1.2 Establishment of a Technical Assistance Partnership

As a result of safety and health concerns and the growing number of surplus facilities, a technical assistance partnership was established in 1993 between the Office of Worker Health and Safety (EH-5), EM-60, the Office of Compliance and Program Coordination (EM-20), the Richland Operations Office (RL), and the Westinghouse Hanford Company (WHC). This partnership, helped achieve enhanced work planning and execution for deactivation of the Hanford Plutonium-Uranium Extraction (PUREX) facility and demonstrated the value of such a partnership—working together to identify the safest, most cost-effective solutions to dispositioning surplus assets. The PUREX technical assistance effort has provided valuable perspectives on how to address and integrate safety and health practices in a project setting such as deactivation.

1.3 Purpose of This Report

This report was developed to share the important safety and health practices and the lessons learned from PUREX with managers, safety and health professionals and workers who are responsible for deactivation projects.

Section 2 describes the events that led to the decision to deactivate PUREX, the safety and health activities that were integrated into the PUREX deactivation project and some important lessons learned. Section 3 provides a discussion on the importance of safety and health integration during deactivation planning and project execution and the steps that are necessary to accomplish this integration. Examples of PUREX practices as they relate to integration activities are highlighted in text boxes throughout Section 3. Section 4 provides a report summary.

The report does not focus on all the elements of a comprehensive safety and health program. Some of these safety and health program elements are addressed by other headquarters guidance and activities such as the EH/EM HAZWOPER initiative and the EH Enhanced Work Planning Demonstration Project. ❑

2.0 Background and Lessons Learned From the PUREX Deactivation

2.1 Background

The PUREX Facility began operations in 1955 specifically to reprocess nuclear fuel to liquid plutonium nitrate. As one of the largest and most efficient of DOE's reprocessing plants, PUREX processed over half of the total plutonium output of the Hanford site. The facility operated in sequence with the Uranium Trioxide (UO_3) Plant, which converted the PUREX liquid uranium nitrate product to solid UO_3 powder.

On July 12, 1990, President George Bush approved the Nuclear Weapons Stockpile Memorandum which stated that plutonium recovered in the PUREX Facility was no longer needed to support nuclear weapons requirements. As a result, Secretary of Energy Admiral James Watkins announced in October 1990 that the PUREX Facility would be placed in standby mode and that an options study and an environmental impact statement would be prepared before the facility could be restarted again. However, on December 22, 1992, DOE issued a final shutdown for the PUREX and UO_3 facilities.

In that same year, DOE initiated planning for the deactivation of PUREX and UO_3 facilities. Deactivation activities have primarily involved removing, reducing and stabilizing the radioactive and chemical materials remaining at the plants, shutting down utilities and reducing effluents. When deactivation is completed, the two plants will be unoccupied and locked, pending eventual decontamination and dismantlement.

When the PUREX deactivation project began, the facility was rated as a Hazard Category 2[6] with significant quantities of fissile and other hazardous materials. These included:

- approximately 208,000 gallons of slightly contaminated 10-molar nitric acid;
- approximately 2.87 metric tons of single-pass reactor fuel;
- approximately 6,000 gallons of plutonium-uranium solution in two process tanks;
- approximately 21,000 gallons of slightly contaminated organic solvent; and
- approximately 15 to 20 kg of plutonium-oxide material in the processing glove boxes.

PUREX Facility

The removal and disposition of these materials were identified early in the PUREX

6 As defined in DOE-STD-1027-92, "Hazard Characterization and Accident Analysis Techniques for Compliance with DOE 5480.23," a hazard analysis that shows the potential for significant on-site consequences (i.e., facilities with the potential for nuclear criticality events or with sufficient quantities of hazardous material and energy, which would require on-site emergency planning activities.)

deactivation project as primary objectives. Other objectives included the general flushing of all facility vessels and lines to meet regulatory requirements and the modification of current systems to meet facility end point criteria.

2.2 Lessons Learned

The PUREX deactivation project, with support from technical assistance partners, resulted in implementation of an integrated safety and health strategy. As a result of employee feedback, management observations and some project performance indicators, the initial results suggest that this strategy has produced several valuable outcomes including:

- improved worker safety, as verified by lost-workday statistics;
- more systematic and thorough evaluations of potential hazards associated with proposed work activities;
- decreased project costs as a result of improved safety documentation development;
- improved employee morale, especially among those involved in the hazards assessment process; and
- better quality Unreviewed Safety Question (USQ) determinations.

As part of the overall strategy to improve worker safety at PUREX, Westinghouse Hanford Company (WHC) management has made a continuous effort to reduce occupational injuries and illnesses through several management programs and systems in addition to the safety and health activities discussed in this report. The cumulative effect of these efforts has been a significant reduction in the occurrence of lost-workday cases at PUREX. Prior to the initiation of this project, the lost-workday case rate reported in October 1993 was 3.8. As of June 1995, no lost workdays have been reported at PUREX in over 660 days, an equivalent of 900,000 person-hours. This translates into an estimated cost savings of approximately $340,000. The average lost-workday rate for DOE was about 1.6 in 1994.

> Cost savings of approximately $500,00 were achieved by streamlining major project documents.

~~A PUREX project support team identified an~~

initial safety and health strategy, which was documented in the PUREX Project Management Plan (PMP). This strategy included proposed upgrades to existing safety authorization basis documents. Based on further review by the project support team and input from EH/EM technical assistance, the safety and health strategy was modified to permit use of the existing Final Safety Analysis Report (FSAR) and operating safety requirements documentation. This assumed reliance on the USQ process to evaluate potential changes resulting from deactivation against the original operating basis assumptions. This modified strategy resulted in a reduction of approximately 9,000 hours from the baseline project schedule because additional project safety documentation was avoided.

Nitric Acid Removal Training Dry-Run

One of the most significant changes resulting from the PUREX integrated safety and health strategy was the ability to evaluate the hazards of proposed deactivation tasks in a graded manner. The PUREX Preliminary Hazards Screening/Assessment (PHSA) process was used to select hazard analysis techniques appropriate for specific project tasks. The process resulted in a more thorough evaluation of hazards while reducing the overall time and resources previously dedicated to hazard analysis activities. Also, knowledge of tasks and awareness of associated hazards increased among personnel and workers involved in the process.

Additionally, by using selection criteria provided by the PHSA screening and modifying the USQ screening form, the team improved the overall quality of USQ determinations by incorporating nonradiological criteria in addition to the existing radiological criteria. This helped ensure that worker safety issues would be evaluated with the same level of detail and concern as authorization-basis issues receive through the USQ process. Given the increased emphasis on worker safety and health, this was a very positive factor for the project.

Prior to implementation of the PHSA process, safety professionals were at the bottom of an informal review chain. Cognizant engineers performed primary safety and health reviews and determined whether work packages needed to be reviewed by a safety and health professional. Work packages were not reviewed by a project team and workers were not part of the review chain.

> The importance of worker involvement was emphasized in the Westinghouse Hanford Company report, PUREX/UO_3 Facilities Deactivation Lessons Learned History. In the scheduling of deactivation tasks, the report states that:
>
> > Personnel who are familiar with large and complex, aging DOE facilities need to be involved in every step of the planning for the deactivation of these plants. The knowledge base is essential in producing realistic schedules for performing deactivation work.

The integrated safety and health strategy was also successful in improving worker morale. In cases where hazard analyses included worker consensus and input, positive changes in worker attitudes were observed. As more workers became involved in the hazards assessment process, other worker suggestions and input were generated with increasing frequency. Overall, worker participation resulted in increased safety awareness and worker efficiency. ❑

3.0 Important Safety & Health Insights of Deactivation Work Planning and Execution

As demonstrated by the PUREX deactivation project, integrating safety and health practices into work activities persists throughout the lifespan of the project. Integration begins when project strategies and controls are being formulated, and continues throughout the planning and execution of work tasks. While this report does not address in detail the complete range of safety and health activities that must be integrated into deactivation projects, it does focus on those important work planning and execution practices that can improve safety and financial performance. As previously noted, these are: (1) use of a graded approach to hazard analysis; (2) early integration of safety and health into planning, engineering and work execution; and (3) use of a multi-disciplinary project team that includes workers.

These safety and health practices are an integral part of the specific activities of a deactivation process, as illustrated by Figure 1 (see page 8). This section will provide a discussion of activities identified in Figure 1 and examples from the PUREX deactivation project to help clarify lessons learned resulting from implementation of these activities.

3.1 Establishment of Multi-Disciplinary Team(s)

The use of a multi-disciplinary project team to perform necessary deactivation planning, analysis and control activities can result in a safer and more efficient deactivation effort. Typically, a multi-disciplinary project team consists of representatives from engineering, planning, safety and health, project management and the workforce that will perform deactivation tasks. Early in the deactivation planning process, it is necessary to identify the disciplines that should participate on the project team and the team's roles and responsibilities. This group should be empowered to make decisions throughout the deactivation effort.

> A multi-disciplinary team approach results in a more efficient planning process, a more comprehensive hazard analysis and fewer opportunities to overlook safety-critical items.

Team composition and size will depend on the perceived hazardous conditions as well as the magnitude of the overall deactivation project. For example, if inventories of radioactive material are to be removed, a criticality specialist may be needed on the project team. Other disciplines that may need to be represented on the project team include industrial hygiene, health physics, and mechanical, electrical, structural, environmental and nuclear engineering.

Teams will also depend on individual worker knowledge and experience to guide decision-making. Experienced workers often have the greatest store of knowledge about hazards that are in the work environment, the condition of facility equipment and systems, the strengths and weaknesses of existing procedures and past facility accidents and incidents. Because of direct hands-on experience, workers can provide valuable feedback on work task feasibility within proposed schedules. They can also provide information about facility process knowledge that may be missing because of poor historical plant documentation.

After team disciplines are identified and representatives selected for team participation, individual team member roles and responsibilities should be determined and clearly documented. One important team function should be the ensurance that safety and

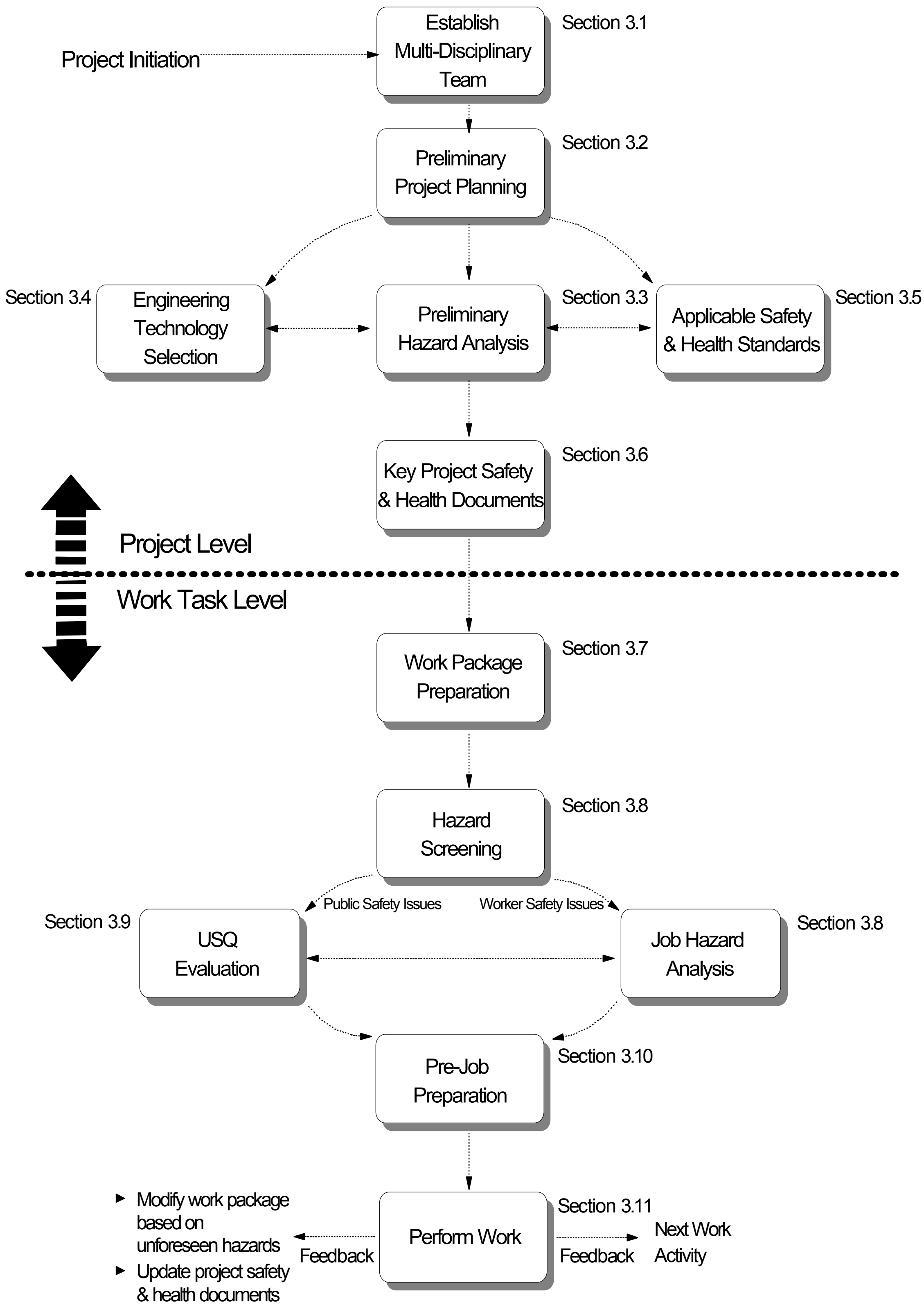


Figure 1. Integration of Safety & Health During Deactivation

Multi-Disciplinary Teamwork

PERHAPS THE MOST critical interface for the successful completion of a deactivation project is the one between engineering personnel and the safety professionals. Their successful teamwork will ensure that the deactivation activities are completed in a safe manner and the remaining facility configuration and systems are consistent with the initial objectives and the end-point criteria.

In the PUREX deactivation project, no example more clearly illustrates this teamwork than the development of the Heating Ventilation and Air Conditioning (HVAC) modification. The HVAC system is the primary system that will remain operational during the deactivated state. These modifications will take the existing 11 PUREX ventilation stacks and combine or cascade them into a single exhaust path through the main PUREX stack. Further, depending upon the remaining materials and their form, this system may need to have Technical Safety Requirements (TSRs) associated with its operation. Even if the final facility conditions are such that there are no TSRs associated with this system, its design and operation will clearly impact other areas, such as contamination spread and personnel safety, during surveillance periods. Contributing to the need to develop strong teamwork is the fact that currently over 60 separate design changes are planned as part of the overall modification of this system.

From the early design consideration and discussion stages, safety personnel have been involved in the HVAC modification. However, as the general design was in the later stages of development, two issues were raised. First, what is the operational result of the collective modification, especially with regards to expected flow parameters, system interactions, and failure modes? And second, the need to perform a Unreviewed Safety Questions (USQ) determination on all of the proposed modifications (the 60 separate changes) led to a concern regarding the ability to determine the system interactions of each change. However, per current USQ procedures, one comprehensive USQ could be performed to address all of the modifications.

To resolve both of these issues, engineering and safety personnel conducted several meetings. From these meetings, it was determined that the hazards analysis process used for procedures during deactivation would be applied to the proposed design changes. The safety analyst determined that the appropriate technique would be a Hazard and Operability (HAZOP) study. This HAZOP would determine the overall operability of the system, the potential failures of the systems and their results. A USQ determination would then be completed using the information and results obtained from the HAZOP. This would allow one USQ to be completed with confidence regarding the entire collection of proposed changes.

By the effective interface between the engineering personnel and the safety professionals, the HVAC modification has been evaluated by the HAZOP process and the results are in the process of being finalized and incorporated into the USQ determination. This teamwork will improve the overall product, save project resources by minimizing the time necessary to complete a comprehensive USQ determination and provide valuable input regarding the HVAC system for the end-state safety documentation. ❑

health functions are not duplicated. For example, nuclear safety and occupational safety personnel should collaborate with other necessary disciplines to perform integrated hazard analyses thus avoiding multiple analyses and inconsistent assumptions. The team should function as a cohesive unit and be responsible for activities such as:

- developing a consistent mode(s) of communication for sharing and disseminating team-derived data and information;
- assisting in the identification and review of deactivation work tasks;
- identifying and evaluating hazards;
- recommending appropriate hazard controls;
- identifying other individuals or groups with whom the team must collaborate;
- identifying specific standards or procedures applicable to each team member's area of responsibility and subject matter that may overlap among team disciplines; and
- assessing the impact of team activities and recommendations or decisions on project schedule and cost.

It is also necessary for the team to establish an interface with other project functions and stakeholders, if not already represented on the project team. These include medical services, emergency response, federal, state and local government agencies, local Native Americans, public interest groups and other members of the general public.

3.2 Preliminary Project Planning Activities

Preliminary project planning involves translating project objectives into proposed major deactivation tasks. At this stage, project managers with support from the project team can also estimate ancillary project support activities that are needed (e.g., radiological protection, industrial safety, security, etc.), required resources and project schedules.

The involvement of safety and health project team members during preliminary planning is critical for identifying impacts to project schedule, cost or personnel. Two preliminary planning activities in which safety and health team members should participate are defining deactivation end-point criteria and initial identification of deactivation tasks.

3.2.1 End-Point Criteria

A deactivation end-point represents the agreed-upon facility condition that results after completion of the deactivation effort. This condition is the ultimate goal of deactivation and is characterized by a safe facility configuration that can be maintained until decommissioning is feasible. End-points should reflect the successful accomplishment of overall project objectives and goals and should be based on criteria acceptable to stakeholders and organizations responsible for final facility decommissioning. Financial constraints, compliance drivers and potential impacts to the environment, workers and the public are all factors that must be considered in determining end-point criteria. Because deactivation has the primary objective of reaching a safe facility configuration that can be maintained until decommissioning is feasible, safety and health considerations are a major factor that drive end-point definition. Involvement of safety and health personnel during planning is therefore all the more critical. End-point related information that should be solicited from safety and health personnel include:

- regulations, standards and procedures that may affect the achievement of a desired end-point (e.g., radiation exposure limits in areas where post-deactivation maintenance will be conducted);
- worker risk associated with systems, equipment and hazardous material removal, which may affect the ability to reach facility end-points (e.g., some deactivation activities, such as removal of short-lived radioactive materials, should be delayed until decommissioning in order to allow radiation levels to subside);
- activities that are necessary to verify achievement of an end-point (e.g., radiation surveys, final hazard analysis, etc.); and
- feasibility of maintaining an end-point during subsequent surveillance and maintenance activities (e.g., monitoring and implementing controls for hazardous conditions that remain after deactivation is complete).

3.2.2 Initial Identification of Deactivation Tasks

After identifying the end-point criteria, the project team should begin identifying and scheduling preliminary deactivation tasks. Though available information at this stage in the planning effort may be insufficient to develop detailed work tasks, it should be adequate to permit initial task scheduling. This will help in identifying the sequence of specific facility work areas and provide an indication of where the project team should begin collecting historical information pertaining to previous hazard analyses, accident and incident reports, processes and operations descriptions or engineering modifications using worker knowledge.

Preliminary Planning

AS STATED IN the PUREX Deactivation Project Management Plan (PMP), the planning objective was to: "…identify the activities needed to establish a safe, environmentally secure configuration at both plants, and ensure that the configuration could be retained during the post-deactivation period."

During the planning phase of the PUREX/UO_3 project, the team identified several generic tasks up-front for achieving a deactivated state. In addition to the generic tasks, team members drew up a list of more specific key tasks, such as:

- Chemical Disposition,
- Single-Pass Reactor Fuel (SPR) Disposition,
- Slug Storage Basin Deactivation,
- N Reactor Fuel Disposition,
- Zirconium Heel Stabilization,
- Metal Solution Disposition,
- Canyon Flushing,
- In-Plant Waste Concentration,
- Contaminated Solvent Disposal,
- Support and Ancillary Systems,
- Product Removal Room Deactivation, including N-Cell and Q-Cell, and
- UO_3 Plant Deactivation. ❑

The occurrence of this type of effort early in the planning process can help the project team determine whether initial schedule estimates are reasonable and whether additional hazard analyses may be needed.

Safety and health considerations should be factored into identification of deactivation tasks, particularly when evalulating the feasibility of task scheduling. This includes knowledge of facility areas where work progress might be impacted because of high chemical or radiation contamination, poor structural integrity of buildings and any technical limitations with regard to hazard controls.

3.3 Preliminary Hazard Analysis

A preliminary hazard analysis is the first step in the identification, evaluation, control and communication of hazards that may be encountered during a deactivation project. Information provided by this effort will be used to help determine safety analysis documentation needs, the content of health and safety plans and the applicable safety and health standards that will govern the deactivation project. The preliminary hazard analysis will also serve as the foundation for subsequent task-based hazard analyses.

> A preliminary hazard analysis is the first attempt to identify and understand deactivation hazards.

Generally, a preliminary hazard analysis should be consistent with analysis objectives provided in DOE-STD-3009, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports. Although the level of effort associated with a preliminary hazard analysis will vary, it should encompass the following activities to some degree:

- collecting and reviewing historical facility records;

Establishing End-Point Criteria

AN INDEPENDENT Technical Review Team chartered by EM-60 pointed out, "…that without predetermined end-point criteria, the deactivation project truly lacked a compass." As a result, PUREX formed a Value Engineering Study to define deactivation and decommissioning (D&D) acceptance criteria. However, the Team recognized that with the long lag between deactivation and eventual decommissioning, planners of deactivation projects could not know or anticipate methods, needs, and capabilities of future decommissioning endeavors. The study then shifted focus toward developing a methodology for making deactivation decisions, rather than defining technical end states. This process established a matrix-based approach to deactivation end points. The matrix was dedicated to one structure or space (or a collection of similar structures or spaces) within a given facility. One axis listed the following top six goals considered in deciding which deactivation tasks to complete: (1) protect the deactivation workers and eventual decommissioning workers; (2) protect the public and the environment; (3) prepare the facilities for only quarterly surveillance and maintenance checks; (4) comply with applicable regulations; (5) consider D&D needs insofar as possible; and (6) keep commitments to stakeholders.

The cross axis listed issues and hazards associated with each structure or space—for example, fixed radioactive contamination, nonfixed radioactive contamination, mixed waste, nonregulated waste, fissile materials, OSHA hazards, structural integrity hazards, confined spaces, weather or animal hazards, and fire hazards. Each hazard could then be addressed in light of which actions could or should be taken to mitigate it. The process was further refined to incorporate the following philosophies:

- Every end-point decision should be driven by and clearly linked to major program objectives and goals.
- A safety approach should encourage elimination of hazards, effective facility containment and facility monitoring and control.
- Management should recognize that end-point decisions must be cost-effective, or linked to constraints on resources and methods.
- "Buy-in" or ownership by all affected organizations is necessary for success.
- Measurable completion criteria should be established for work teams in the field.
- End-points should not be driven by D&D assumptions.
- Developing end-point criteria should be iterative.

With these fundamentals, end-point criteria were matrixed and ranked. A further discussion of this process can be found in WHC-SP-1147, Rev. 0, "PUREX/UO_3 Facilities Deactivation Lessons Learned History." ❑

- conducting a physical survey of the facility; and
- evaluating findings.

Many surplus facilities subject to deactivation have Safety Analysis Reports or other similar safety documents available that provide an analysis of hazards associated with past facility operations. Therefore, in many cases the preliminary hazard analysis will consist of evaluating how the configuration of a process, system or piece of equipment has changed as well as hazardous material inventories compared with the last documented hazard analysis performed.

3.3.1 Collection and Review of Facility Historical Information and Records

Understanding the history of a surplus facility's past operations provides a baseline for measuring or defining current hazardous conditions that must be dealt with in deactivation. The effort necessary to accomplish this objective will vary depending upon the availability and quality of safety documentation and facility records. For example, a facility with up-to-date safety analysis documentation may reflect the actual facility condition and require less effort than a facility that was abandoned, was not subject to routine surveillance and maintenance, or did not have up-to-date records.

Preliminary Hazard Analysis

IN PERFORMING the PUREX graded, preliminary hazard analysis, the PUREX safety and health team aimed to enhance the worker and occupational safety baseline knowledge for the deactivation project Although PUREX safety documentation had already defined the nuclear safety and radiological hazards and concerns associated with facility activities, it had not addressed nonradiological hazards. This omission arose primarily from the brief time frame in which most of these documents were prepared (that is, predated DOE 5480.23). As a result, the team prepared a HASP-like document for the PUREX deactivation project. The document was to address the lack of formal information about the occupational and worker safety issues for the facility. Based on the above-mentioned conditions and deficiencies and the deactivation project's expected 4-year length, a 2-week baseline effort was planned. To write the baseline analysis, the team selected a certified safety professional with a strong industrial safety background and an experienced industrial hygienist. No worker was assigned to this task. Later, however, team members realized that a worker should have been regularly involved. However, the two safety and health professionals did routinely discuss items with facility workers.

The main focus of the baseline effort was on safety hazards affecting the nontransient (permanent) workers throughout the facility. Other conditions were to be addressed as identified. For the PUREX deactivation, it was determined that the most user-friendly format for the information was a matrix, in which hazards would be grouped by section of the facility. By using this format, the baseline provided information useful to engineers in work planning and development, and equally by workers as part of their pre-job review of work activities. A number of safety hazard were identified by the PUREX hazards baseline activity. These included:

- egress difficulties in a number of areas of the facility,
- the use of temporary wiring for permanent or semipermanent equipment,
- noncompliances with scaffolding and slings in several areas, and
- standing water puddles in some areas of the facility.

The entire baseline document has been assigned to a risk prioritization group for evaluation and ranking. However, for the nontransient hazards identified, such as egress problems, it is unlikely that facility modifications to address these conditions will be implemented in the remaining 3 years or less of the project. To address these hazards, proper controls must be identified. For egress, one such control would be to limit the number of people in the area during the work activity.

From the start of the preliminary hazard analysis process, it was predicted that the baseline would need frequent updating because the activities were bound to change in response to findings. The first update effort was performed in mid 1995. For the update, the scope and areas of the facility are being expanded to include “out-buildings” and support trailers. ❑

Information that should be considered for review includes:

- Safety Analysis Reports or other documented hazard analyses;
- as-built drawings, including process and instrumentation diagrams and equipment specifications;
- construction photographs;
- incident reporting data;
- material safety data sheets or other hazardous material inventory records; and
- accident investigation reports.

As mentioned, workers may be excellent sources of valuable historical information. Worker interviews are particularly important when facility documentation is incomplete or out-of-date. Worker knowledge may be the only source for identifying past incidents, facility modifications not shown on existing process and instrumentation diagrams, or hazardous materials that may have been used or stored in the facility. Where possible interviews should be conducted with facility managers, maintenance personnel, operators, shift supervisors and safety and health personnel.

3.3.2 Physical Survey of the Facility

Even after a review of facility historical information, knowledge may be limited on the configuration or condition of existing facility systems and equipment, as well as existing quantities of hazardous materials. A physical survey is a valuable activity that can fill these information gaps. Its objective is to verify the existence of perceived hazards and identify hidden hazards through facility walkdowns that involve visual observation, sampling or monitoring activities.

Facility walkdowns should be conducted by engineering, safety and health personnel and workers, all of whom are trained in hazard recognition. Specific facility conditions and characteristics will dictate the required expertise that may be necessary. For example, if the facility is old and not well maintained, a structural engineer may need to participate in walkdowns. Walkdown participants should use checklists, logbooks, video or still cameras or other reliable means for recording findings and observations.

It may also be necessary to conduct air monitoring and sampling to provide information on identified or suspected hazards, pinpoint sources of hazards and detect hazards that might otherwise go unnoticed. Potential concerns could include flammable atmospheres, oxygen-deficient atmospheres or high radiation levels.

All workers involved in physical surveys should be appropriately protected. Participants should be briefed on the objectives of the walkdowns and all known hazardous conditions in areas to be visited. Also, appropriate personal protective equipment should be available and used as prescribed.

The survey should be carefully planned so that all organizations get the information they need from a single walk-through. It is especially important that health and safety, waste management and environmental personnel participate.

> Having a fundamental understanding of the hazards will help determine the breadth and depth of safety and health activities, such as radiation protection, exposure assessment, medical surveillance and emergency response.

3.3.3 Evaluation of Findings

Information derived from the historical information reviews and physical surveys should be used by the project team to determine the potential hazards and the necessary preventive or protective measures. Even without detailed information on work tasks at this stage, this effort will be useful in future development of individual work packages.

This information should also be used to determine the potential impacts to the existing facility authorization basis. The Unreviewed Safety Question (USQ) process should be performed on the tasks that have been identified for the deactivation project. Application of this process should be based on currently available information, and revisited during work package preparation.

3.4 Integration of Safety and Health Into Engineering Support Tasks

Engineering personnel play a key role in the selection and definition of deactivation tasks, reviewing existing work plans and procedures, and designing new equipment that is necessary for some deactivation tasks. While the engineering focus is primarily on accomplishing these tasks, this emphasis is broadened with the inclusion of safety and health personnel and workers who possess familiarity with facility operations and deactivation activities.

> By involving safety and health personnel in engineering activities, hazards can be cost-effectively designed out of activities and technologies can be selected that offer the least amount of worker risk.

Because the focus of safety and health personnel is on the identification and elimination or control of hazards, they need to interface directly with engineering personnel to ensure that hazards are designed out of deactivation tasks. Safety and health personnel can identify the applicable requirements and standards that must be met or considered for this purpose. They can also relate lessons learned that may have evolved from past occurrences or accidents.

Engineering personnel may begin new equipment design as early as feasible to support certain deactivation tasks. This new equipment may introduce new hazards for those who have to install, operate, maintain and dismantle this equipment. Safety and health personnel can identify these hazards early enough so that the hazards can be eliminated or controlled properly, and safe and proper procedures for equipment use can be developed. This interface can also help to determine the necessary inspection criteria for enhancing equipment reliability and safety.

While the greatest potential benefit of having safety and health personnel work closely with engineering personnel is early hazard recognition and elimination or control, the secondary benefit is overall project cost savings from reducing or eliminating the need to reengineer, reanalyze or retrain due to unforeseen safety and health conditions.

3.5 Applicable Safety and Health Standards

Deactivation projects are subject to myriad safety and health requirements including federal, state and local laws, departmental orders and technical standards and nationally and internationally recognized consensus standards. Consistent with Defense Nuclear Facilities Safety Board (DNSFB) 90-2, DOE management and operating contractors have relied on the Standards/Requirements Identification (S/RID) process to define safety and health standards that are applicable to their respective operations. This process was also implemented at PUREX.

The Department's Standards Program is currently developing a process for identifying the necessary and sufficient (N&S) set of standards for all DOE work, including deactivation. A N&S set of standards is one that (a) meets the performance expectations and goals for the work (including complying with laws and regulations, and providing adequate protection for the workers, public and environment); and (b) contains only the standards which are necessary for the given work activities and the associated hazards under consideration. This process is intended to resolve many of the S/RID-related issues identified during PUREX deactivation (see example box on page 16). The N&S process consists of the following steps:

- initiating the N&S closure process for each project;
- compiling or developing a N&S set of standards;
- incorporating these standards into work planning; and
- evaluating work performance against these standards.

At the time of this publication, the Department's N&S Standards Process was in the pilot demonstration phase. Regardless of the formal process established by DOE, there are several fundamental activities that are essential to cost effective identification and implementation of safety and health standards:

- identifing the safety and health standards that are applicable to the project based on hazards and the type of work to be performed;

Determining Safety & Health Standards

THE DETERMINATION of applicable safety and health standards for the PUREX deactivation project was performed as part of the Standards/Requirements Identification Document (S/RID) process in response to Defense Nuclear Facility Safety Board (DNFSB) Recommendation 90-2. As opposed to early identification of the safety and health requirements for the project in advance of program and procedure development, performance of the PUREX process was based on the operational programs and procedures. The primary objective was to determine the minimal set of requirements that applied to the PUREX deactivation project and, thereby, to reduce the current requirement base and potentially the costs to the project, especially in surveillance and maintenance.

Facility subject-matter experts used the current WHC process, including an ES&H database, to screen requirements to determine those applicable to facility deactivation. Though efforts were focused on eliminating requirements that did not apply to deactivation, the resulting list of requirements was extensive. Based on the format of the database, few complete requirements could be eliminated. The facility conditions and activities contributed greatly to the remaining number of applicable requirements.

Although a number of requirements were eliminated from the initial database screening, the goal of significantly reducing the requirements and associated costs has not been achieved. Based on current requirements identified, the programs and procedures in place at PUREX are not expected to receive major revision at this phase of the S/RIDs process. Overall, benefits to the PUREX deactivation project from this process have been lower than anticipated. Factors contributing to the negligible benefits from the S/RIDs process include: 1) the format of the requirements database such that few requirements could be excluded completely, and 2) the existence of PUREX manuals and procedures that already implements most generally applicable requirements. ❑

- using the project team to interface with stakeholders in order to reach consensus on the applicable safety and health standards;
- confirming that the safety and health standards are adequate for protecting workers, the public and the environment, and that they can be implemented given facility staffing, expertise, hazards and available technologies and funding;
- obtaining stakeholder approval on the set of standards;
- incorporating safety and health standards into existing facility operating policies and procedures; and
- continually assessing work performance against identified sets of standards.

3.6 Key Project Safety and Health Documents

In accordance with several DOE and external safety and health directives, project managers must provide documentation that state how worker and public safety and health will be protected from any adverse impacts associated with deactivation activities. Facility Safety Analysis Reports (SARs) and Health and Safety Plans (HASPs) are two key documents that provide the basis for assuring that public and worker safety and health protection have been evaluated and controls established. Cost-effective considerations for developing these documents should include:

- an evaluation of the need for safety documentation upgrades based on the ability of existing documents to accurately reflect deactivation conditions, including current work activities and hazards; and
- use of the multi-disiplinary project team to help produce safety and health documentation and evaluate opportunities for consolidating major safety and health documents.

Streamlining the safety and health document preparation process can potentially:

- reduce the cost of developing authorization-basis safety documentation;
- reduce duplication of effort; and

Project Safety & Health Documentation

THE PUREX FINAL SAFETY ANALYSIS REPORT (FSAR) was developed in the late 1980s. Judged by current standards, it did not adequately address nonradiological concerns. Additionally, it was not consistent with current DOE guidance on content and format. A number of controls currently identified as Operational Safety Requirements (OSRs) did not meet the current criteria for this classification.

To avoid the prohibitive cost of development (and the limited benefit) of an upgraded SAR for the deactivation project, PUREX had to develop and implement processes and controls to address these concerns. The DOE-RL and HQ personnel decided that the existing FSAR would be used as the authorization basis for deactivation. To ensure that nonradiological and radiological issues were properly addressed, the USQ process would be used with identified acceptance criteria.

The use of this process saved the cost of development, review and approval of a new SAR for deactivation. Because the PUREX facility is currently a hazards class 2 facility, per DOE-STD-1027-92, with DOE 5480.23 criteria, the cost of this document and the DOE reviews would have been extensive. Additionally, the issue regarding the continuation of the deactivation project during the year to develop and approve this document would have been counter to the overall objectives of deactivation. ❑

- produce a more comprehensive hazard identification and evaluation process.

3.6.1 Facility Safety Analysis Document

A safety analysis document such as a SAR is a key and necessary document for authorizing the deactivation of nuclear or non-nuclear facilities. For facilities in which a SAR was written for operations, the project team should determine whether the SAR must be modified or upgraded to meet requirements of DOE-STD-5480.22 Technical Safety Requirements and DOE 5480.23 Nuclear Safety Analysis Reports. As discussed in DOE-STD-3011-94 Guidance for Preparation of 5480.22 (TSR) and 5480.23 (SAR) Implementation Plans, SAR upgrades depend on three factors:

- whether existing safety documents are consistent with the latest requirements of 5480.22 and 5480.23;
- whether the current facility configuration is adequately documented in the existing SAR; and
- the duration of the facility's remaining life. If a facility's operational life is short, a SAR upgrade may not be necessary.

Necessary SAR upgrades can be cost-effectively executed by:

- following a graded approach to SAR development, as discussed in DOE-STD-3009;
- using activity-specific documentation such as safety analyses of common activities that can be applied to numerous projects or work tasks in the SAR; and
- establishing documented and approved measures that define the facility safety basis and ensure its integrity, such as a USQ screening process.

If the deactivation project is of short duration, it may be appropriate to only document the facility safety basis and current configuration as a Basis for Interim Operation (BIO) document until a decommissioning mission is finalized (see DOE-STD-3011-94 for specific details).

3.6.2 Health and Safety Plan

A Health and Safety Plan (HASP), or equivalent document, is the principal safety and health document that ensures worker hazards are identified, evaluated, controlled and communicated. DOE-EM-STD-5502 Hazard Baseline Documentation provides direction on the type of facilities that should have a HASP.

HAZWOPER/HASP Requirements

THE DEVELOPMENT OF a "HASP-like" document was identified in response to the EH-5 comments on the PUREX Deactivation Project Management Plan. Early in the project, it was determined that the PUREX deactivation project did not need to meet the requirements of 29 CFR 1910.120. It was agreed however, that to better define not only the worker hazards associated with the deactivation project but also the controls and programs to address these hazards, a document consistent with a HASP should be developed.

From its inception, all parties agreed that development of the PUREX Health and Safety Document (HASD), as it later became known, would be a graded process. The objective was to identify the hazards and safety-related programs associated with the PUREX project and communicate that information to the workers. As a result, requirements of 29 CFR 1910.120 would be incorporated into the HASD only as they provided value to the document in identifying or reducing hazards.

Performing the hazards baseline was a key element in the early development of this document. The HASD went beyond the baseline assessment, becoming a reference for those wishing to identify programs and organizations at PUREX and WHC that were designed to address hazards and improve worker safety.

Since the majority of required safety and health programs were already in place and documented, the HASD did little more than provide a roadmap to these programs and the related manuals. The portion of this effort that was most valuable was the related hazards baseline activities because identified worker safety related hazards were the least documented area of PUREX related hazards. Overall, the PUREX conclusion was that development of a HASP or similar document should be considered based on how well existing documentation addresses worker hazards and their controls. ❑

The purpose of the HASP is to identify and document the types of worker hazards that may be associated with specific cleanup tasks, and to establish appropriate hazard controls. This information is documented primarily for use by the worker before a given work activity begins. It also provides a baseline or inventory of hazards against which unforeseen hazards can be evaluated. Before preparing a HASP, the following documents should be reviewed for potential applicability:

- OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response—written to protect workers involved in hazardous waste cleanup activities;
- DOE/EH-0478 Handbook for Occupational Safety and Health During Hazardous Waste Operations—provides guidance on HASP development; and
- DOE-EM-STD-5503 Health and Safety Plan Guidelines—provides suggestions for accepted format and content for HASPs.

3.6.3 Safety Analysis and HASP Commonalities

Requirements for safety and health documentation are specified by the HAZWOPER standard and DOE safety analysis requirements and standards, including a systematic approach to identifying hazards and documenting hazards and controls. As a result, many opportunities exist for integrating information during the development, modification or upgrade of documents used to guide a facility deactivation project. This is particularly valid for low hazard facilities where worker impacts are the only focus of safety management activites. In this case, both HASPs and SARs share similar purposes. DOE-EM-STD-5502-94 provides useful information for integrating safety documentation.

3.7 Task-Specific Work Package Preparation

As the level of detail of available information (e.g., hazards, risks, and end-point criteria) improves during the planning phase, more detailed work tasks can be developed and scheduled. These tasks should be identified, evaluated and controlled within the facility's existing job control system. Work packages (other terminology may be used by various DOE sites) are an important part of this system because they provide the details of the work to be accomplished and verification that safety and health impacts have been evaluated before work begins.

The work package can also be developed for a physical survey (such as the kind required by HAZWOPER), equipment removal or a specific maintenance action. To be most effective the work package should include:

- a description of specific activities;
- identification of the type of hazard analysis required for the activity, and verification that the analysis was performed;
- a method to ensure that identified hazards associated with each planned activities are documented and shared with workers together with the steps to eliminate, minimize or reduce those hazards to an acceptable level;
- all necessary work permits;
- appropriate training required for the planned activity;
- references to or inclusion of all supporting documentation;
- equipment and material to be used;
- personal protective equipment (PPE) needed;
- a description of management structure, including necessary reporting and communication channels;
- emergency response activities if applicable;
- additional engineering studies if required; and
- expected results at completion of the activity.

3.8 Task-Based Hazard Screening and Analysis

Because deactivation involves both nonrepetitive and repetitive work tasks, a systematic process should be in place to identify and evaluate task-specific hazards, before work is conducted. This process should identify potential causes of accidents, their effects and necessary preventive or protective measures. Resulting information should be incorporated into health and safety plans and safety analysis documentation.

Not all work tasks are equally hazardous or complex. Therefore, a task-specific hazard analysis process should be graded to account for these factors. For example, if a work task such as a previously conducted maintenance activity is documented in current procedures and well understood, an in-depth analysis would not be necessary. It would be sufficient to have safety and health personnel review job steps and rely on simple techniques, such as a hazard checklist. If major changes have been made to existing procedures, or if the procedures are to be performed in an unfamiliar work environment, a more detailed analysis would be warranted. This would involve a job hazard analysis conducted by members of the project team. If the work task is perceived to be highly hazardous and complex, a more in-depth systematic hazard analysis technique such as a Hazards and Operability Study or Failure Modes and Effects Analysis may be needed. These hazard analysis techniques are traditionally used in nuclear accident analyses and recommended by the Process Safety Management regulation (29 CFR 1910.119).

Task-Based Hazard Screening

EACH WORK ACTIVITY that requires an engineering study or uses a work plan or procedure is screened by an experienced safety analyst with the cognizant facility personnel. This screening is documented on the Preliminary Hazard Screening/Assessment (PHSA) form (Appendix B) and provides the basis for determining the appropriate level of additional analysis/evaluation. The grading process was essential to the hazard analysis process implemented at PUREX.

The two-part PHSA screening form was developed specifically to assist in and document this grading process. Part I of the screening form consists of two general areas for consideration: the characteristics of the activity and the perceived risk, which is designed as a general checklist.

Part II consists of a number of questions designed to better define the hazards associated with the proposed activity. In the sample form, Part I indicates that the nature of the hazard is toxicological and radioactive, while Part II identifies the material as acid contaminated with fission-product materials with the total quantity of material to be handled as 100 gallons. By completing both of these sections, the analyst and the cognizant work preparer are able to gauge the overall relative hazard of the proposed activity.

Using the completed PHSA form, the analyst and the cognizant preparer determine the appropriate level of additional analysis to be performed. Determination of the appropriate level is based on the relative complexity, hazards and facility experience associated with the proposed activity. A recommendation is then made by the analyst and cognizant engineer regarding one of three possible levels of analysis in this process. It is important to note that the PHSA screening and the related grading guidance criteria are neither all inclusive nor designed to provide a "pat" answer. They are merely tools by which the experienced analyst can more rationally assess whether additional analysis is necessary. Hence, a judgment is inevitably based on the experience of the analyst and the cognizant engineer. So while this process does not preclude the second-guessing often associated with this type of work, it provides a useful tool and appropriate documentation to help reach the conclusion.

The minimal analysis (Level 1 in Appendix B) is completion of the work activity in accordance with current WHC requirements and procedures. This level includes completion of a hazards checklist, review and approval of the proposed work activity by applicable safety professionals, and other actions mandated by WHC procedures.

Moving higher in rigor, the next level of analysis—Level 2—is the Job Safety Analysis (JSA). The JSA is performed in addition to the current WHC requirements. A small team is assembled, comprising the cognizant engineer, a nuclear safety professional, an industrial safety/hygiene professional, a worker and a lead analyst. The team reviews each section of the proposed work activity and identifies specific hazards associated with completion of that procedure section.

Additionally, the team identifies any programs or systems that are particularly critical to the safe execution of this activity. They then recommend appropriate controls or reviews to prevent, control, or mitigate the identified hazards.

Because this process is used for less complex and lower-hazard activities than those requiring a more rigorous analysis, the JSA can be completed in much less time. JSAs performed at PUREX have generally been completed in less than 4 hours, from the start of the meeting to completion of the final hazards matrix. A key to this technique's success has been the inclusion of workers on the team. The workers selected to serve on this team have been very knowledgeable of the process and systems being evaluated, and their input has greatly enhanced the process. Although, many of the changes identified in this process are not directly linked to safety. However, since these changes have made the written procedures more usable, safety can only be enhanced.

In the highest level of analysis—Level 3—a team conducts a more formal and detailed hazard analysis, such as a Hazards and Operability (HAZOP) analysis or Process Hazards Assessment (PrHA). The Team is led by a qualified, experienced hazards analyst. In addition to completing the hazard analysis, all of the S/RIDs functional areas are evaluated item-by-item to determine any critical programs or systems that affect the safe execution of the work activity. The team then recommends the necessary measures to prevent, control, or mitigate identified hazards.

Because Level 3 analyses are performed only on high-hazard or highly complex activities, they require significantly more time to complete than the JSA. In the PUREX deactivation project, the average HAZOP or PrHA required 2 weeks to complete over a series of half-day meetings. For example, Level 3 analysis was performed for the off-loading of nitric acid for shipment from the facility. Since the bounding, non-radiological accident was based on the failure of the nitric acid storage tanks and the procedure to be evaluated involved the transfer of this material to a tanker truck, no PHSA screening was performed. The method of analysis selected for was a HAZOP.

A team of six contractor personnel including a worker, nuclear safety engineer, industrial safety and hygiene professionals, the cognizant work preparer, and two analysts were assembled for this analysis. In the preparatory work for this analysis, thirty-three nodes were identified to be assessed. This process required approximately three weeks of analysis and clerical work to complete and document.

This assessment indicated that the most credible accident was the spill of nitric acid storage tanks to the surrounding area. This scenario was well bound by the catastrophic failure of the nitric acid storage tanks and therefore no additional consequence analysis was necessary. As a result, all of the recommendations were incorporated into the procedures and the final result was an increase in the safety awareness for completion of this activity. ❑

A hazards screening process is a useful tool for selecting which hazard analysis techniques are suitable for planned work tasks. Screening criteria should be developed using results of the preliminary hazard analysis and any known details of the work task. Examples of specific information that should be assessed in the screening process include:

- the type of activities involved in the work task (e.g., cutting, hoisting, crane operation, handling of hazardous materials);
- existing procedures that cover work task activities;
- an assessment of whether the activity has been previously performed in the facility or is an activity with which facility personnel have little experience;
- an assessment of whether the activity is routine or places extra or unusual demands on systems or personnel; and
- a listing of hazardous materials and quantities used or encountered in the work task.

DOE STD-3009 provides some considerations for selection of hazard analysis techniques, and may be adaptable to deactivation efforts.

Independent of the types of task-based hazard analyses performed, the project team or a subset of the team, including worker representatives, should perform the analyses. This will avoid duplicative efforts among safety and health organizations (i.e., nuclear safety, industrial hygiene, etc.) and inconsistent analyses assumptions.

A hazard screening process was employed in the PUREX deactivation project. Appendix A provides an overview of the PUREX process, and Appendix B provides PUREX Preliminary Hazard Screening Assessment forms used by the analysis team.

3.9 Task-Based Evaluation of Potential Impacts to Deactivation Authorization Basis (USQ Process)

As a final check, information from the task-specific hazard analysis process should be used in a USQ screening process to ensure that impacts of hazards have been considered within the facility authorization basis. The USQ process should be continuously applied to the deactivation project from initial project planning through the execution of each work task. Evaluation of the project activities, particularly as conditions change during deactivation, is important to ensure that both radiological and non-radiological hazard levels are maintained within the prescribed authorization bases.

It is important to determine whether the proposed work is within the defined boundaries of the authorization basis. Just as activities associated with the work are screened for occupational hazards, potential safety and health impacts to the public must also be addressed. As detailed in DOE Order 5480.21 Unreviewed Safety Questions, the USQ process provides instructions and guidance on how to review activities to help ensure that:

- activities do not explicitly or implicitly affect the authorization bases of the facility; and
- activities do not result in an action that could violate the facility Technical Safety Requirements.

A screening process may be utilized to determine whether or not a USQ exists. The USQ process should address and document an evaluation of the seven questions defined in DOE Order 5480.21, Section IV.2.b. If evaluation of an activity indicates that one or more of the screening questions cannot with reasonable assurance be answered as "yes," a USQ exists. The existence of a USQ does not necessarily mean that the activity is unsafe. The purpose of identifying a USQ is to alert

USQ Screening

THE KEY to successful task-level integration of worker safety and authorization basis issues is to unite the hazards screening/analysis process with the USQ process. This union ensures that the proposed task is evaluated for all levels of safety concerns and for its impact to the current authorization basis. For the PUREX deactivation project, the USQ process then in use by WHC was modified, both by the authorization basis definition and by a revision to the screening form.

The authorization basis definition requires the use of the USQ process to assess whether the potential for radiological and nonradiological accidents satisfy the identified risk-acceptance criteria. To successfully perform this task, the cognizant work preparer and safety analyst must determine the maximum credible accident and the quantities and types of materials that would be involved. This information is clearly identified in the PHSA process, and is then used to determine whether a formal consequence analysis is needed.

The information from the PHSA screening form is used to complete the USQ screening. In this way, the proposed activity's impact on the authorization basis is evaluated and documented. The same individuals who conducted the PHSA conduct the USQ process; reducing the time needed to complete the screening and improving the quality of the assessments.

The USQ screening form for PUREX deactivation (Appendix C) was developed to make the form more usable for process and design engineers. The introduction section of this screening form responds to an audit finding. The finding indicated that current screenings often were not sufficiently documented to serve as stand-alone documents. As a result, the introduction section requires discussions of the issue being evaluated, the operating parameters and systems affected, and the bounding authorization basis accidents.

The questions in the form's screening section were developed so that facility staff would find the form easier to use. The questions do not speak in abstract language familiar only to safety analysts, but rather address everyday subjects well-known to most evaluators. Although there are more questions on this screening form, the USQ screenings can be completed as quickly as before. This is because the terms and questions are more specific and more familiar to the evaluators and use information from the PHSA. ❑

facility management and the DOE of actual or potential conditions that affect the DOE approved authorization basis. Upon confirmation that a problem exists, it will be necessary to substantiate that the facility is placed in a safe configuration pending completion of a safety evaluation. Submission of a safety evaluation that supports a modified authorization basis and approval by DOE are required prior to proceeding with the activity.

3.10 Pre-Job Preparation

Before individual deactivation work tasks are conducted, it is necessary to conduct pre-job briefings of all the procedures to be performed, review the hazards and adopted controls associated with the deactivation tasks, review emergency procedures and ensure that procedures are in place to handle unforseen hazardous events. This is particularly important if it is a new or unfamiliar task. Conducting mock-up training may also be prudent under certain circumstances, if, for example, the task is intricate, complex or conducted in a hazardous environment. This stage also provides an excellent opportunity to verify that all applicable permits are in place, the emergency response plan is ready for implementation and personnel have completed appropriate training.

3.11 Safety & Health Activities During Project Execution

During the performance of deactivation tasks, project managers and other responsible personnel must ensure that hazard controls and work practices are monitored for adequacy. Also, established feedback mechanisms should be in place to provide information on

Radiation Probe Incident

IN FEBRUARY 1995, a ten foot long sample probe was removed from the PUREX canyon ventilation exhaust duct. The probe was being replaced with a new probe so that existing contamination would not affect characterization data on the current canyon ventilation stream. The probe was successfully removed, double bagged and temporarily stored in an auxiliary building. In order to fit in a low level waste burial box, the probe was cut into two sections. While this cutting was successfully completed, a number of problems occurred resulting in the declaration of an off-normal occurrence.

These problems included completion of the probe cutting without the existing work package and associated special radiological work permit and health physics support. The root causes of these deficiencies was poor communication between the parties involved and the failure to include waste disposal personnel in the work planning process.

The actual safety significance of this event was relatively minor. It resulted in a contamination spread of 200,000 dpm beta-gamma and 14,000 dpm alpha in an existing contamination area. However, the potential safety significance was much larger since the personnel performing the work did not fully understand or question the contamination levels on the probe.

There are a number of lessons to be learned from this event:

(1) Open and honest reporting is extremely important. In this case, the people involved in the event were candid and forthright. This was acknowledged by the DOE-EH Office of Enforcement as being very positive.

(2) Personnel must absolutely understand the magnitude of the hazards with which they are working. A healthy skepticism and constructive questioning attitude are important qualities. In this case, a minor change in the scenario could have resulted in a significant internal intake of contamination.

(3) Compliance with requirements and procedures is absolutely necessary. The desire to get a job done quickly does not justify ignoring safety requirements. In this case, a critical plant resource was not involved because it was felt their participation would make the job more difficult. Teamwork is essential to the safe completion of the project.

(4) Communication and establishment of organizational interfaces is critical to the project success. A number of people had information, that if shared, would have prevented this event from happening.

This event succinctly illustrates the value and need for performing those activities mentioned in section 3.11.❑

unforeseen hazardous conditions and corrective actions that must be implemented.

The extent and type of monitoring activities such as air monitoring, exposure assessment and medical surveillance will depend on the type of hazards that may be encountered, the time in which workers may be present in a given hazardous work area and how much is known about the work environment. For example, air monitoring is of particular importance for work areas in which friable asbestos may be disturbed.

Worker feedback mechanisms can include daily pre-job planning meetings, stop-work authority given to workers, employee suggestion programs and surveys, worker involvement in review of safety and health procedures and the inclusion of workers in accident and incident investigations.

Feedback mechanisms can only be effective with management support and commitment. Managers must empower workers to provide feedback, solicit their feedback and respond to or use worker recommendations for improvements. Both managers and workers must understand their rights and responsibilities related to maintaining safety and health, which includes the right to stop work under certain hazardous conditions as an additional means of empowerment. These steps will not only improve the feedback process, but can also improve worker safety, morale and productivity.

Feedback is an important safety and health consideration during execution of deactivation tasks that helps identify unforeseen hazardous conditions and changes in the work environment.

Monitoring and worker feedback can help identify significant changes that can affect or alter safety and health planning assumptions. For example, changes in operations such as the addition or modification of tasks, processes, tools, equipment, personal protective equipment or work practices may occur such that new hazards or hazardous conditions emerge that were not identified during planning. The USQ process should be used to assess the impacts these changes may have on original hazard analysis assumptions and documentation.

Finally, periodic audits and inspections are an essential element to help assure safety and health performance is adequately maintained. These activities should also be used as a form of feedback for improving hazard control and management as well as overall safety and health performance. ❑

4.0 Summary

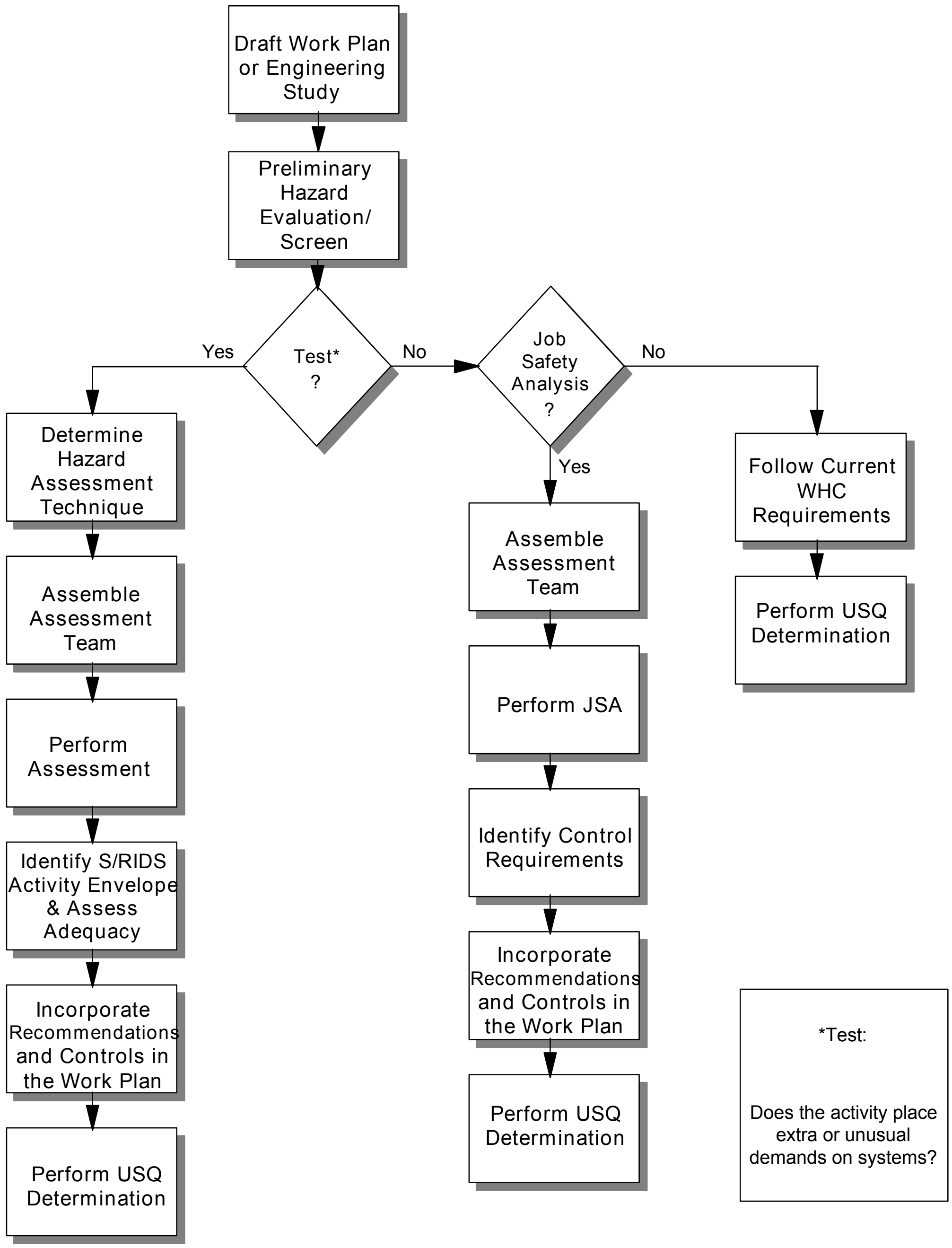
As a result of the lessons learned from the PUREX deactivation project, useful practices and important insights were gained related to the integration of safety and health practices into deactivation work planning and execution. Many of these practices have applicability to other Departmental operations such as facility decommissioning, site remedial actions and waste management. This report has provided an overview of three essential and broadly applicable insights for use as guidance. These insights can be summarized as follows:

- Graded Approach to Hazard Analysis—conduct project level preliminary hazard analysis to provide hazard information for planning, engineering evaluation, determination of applicable safety and health requirements and determination of safety and health analysis and documentation; and conduct a task-based analysis for each work task that is commensurate with hazard types and work activity complexity.

- Involvement of Safety and Health Personnel in Project Planning, Engineering and Execution—involve safety and health professionals early in the planning process, and maintain their involvement throughout work execution in order to address safety and health issues during engineering technology selection to minimize risks to the workers, public and environment; and minimize and reduce duplication of effort during project safety and health documentation development.

- Use of a Multi-disciplinary Project Team (including workers)—use team approach to develop and accomplish project and work task activities; ensure clear lines of communication and information sharing, reduce duplication of effort; and solicit worker involvement in all aspects of deactivation, particularly in assessing hazards and the adequacy of hazard controls, and in obtaining feedback on unforeseen hazardous conditions during actual work. ❑

Appendix A: PUREX Task-Specific Hazard Screening Process



Appendix B: PUREX Preliminary Hazard Screening Assessment

PUREX Example: Preliminary Hazard Screening Assessment (PHSA) - Steam Restart
Part I

Characteristics: This screening is to evaluate the request from the Surveillance and Maintenance personnel to determine if a hazards analysis could provide assistance in the minimization of steam related incidences and thereby increase the safety of these activities.

I) Complexity/Size	Simple/small_	Complex/large x	
II) Type of Process	Chemical_	Electrical_	
	Physical x	Electronic_	Mechanical x
	Computer_	Biological_	Human x
III) Type of Operation	Fixed Facility_	Transportation_	
	Permanent x	Temporary_	
	Continuous_	Semi-batch_	Batch_
IV) Nature of Hazard	Toxicity_	Reactivity_	
	Flammability_	Radioactivity_	
	Explosivity_		
	Other x Criticality_		
Steam energy and the heat itself.			
V) Event of Concern/Scenario	Single Failure x		Loss of function event_
	Procedure_		Multiple Failure_
	Process upset_		Software_
	Simple loss of containment event_		Hardware_
	Human_		

Perceived Risk & Experience

I) Length of experience:	Long x	Short_	none_
	with similar process_		
II) Accident Experience	Current x	Many x	
	Few_	None_	
III) Relevance of Experience	No Changes_	Few Changes x	Many Changes_
IV) Perceived Risk	High_	Medium x	Low_

PART II

What is the basic process or procedure?
The process being considered is the current procedure for the introduction of steam to the various sections of the PUREX facility.

What hazardous material is being handled or processed?
The material of concern for this procedure is the steam. Steam is used throughout the PUREX facility for a number of items.

Preliminary Hazard Screening Assessment (PHSA). (part 1 of 2).

PUREX Example: Preliminary Hazard Screening Assessment (PHSA) Steam Restart
Part II

How much material is present altogether?
The quantity of steam is not an issue, rather the pressure and control of its introduction to the PUREX systems.

How much material is being handled/processed at one time?
The concern is the operation of individual valves to introduce steam to the portions of the facility.

What can go wrong during the handling or processing?
The introduction of steam to a line containing water can result in a "hammer" that can lead to the rupture of the equipment and potential injury to the worker.

What is the worst process or OSR/OSD related accident possible?
Though there are currently OSR/OSD's related to operation of systems using the steam, water hammer resulting from this procedure would not be expected to result in an OSR/OSD occurrence.

What is the worst accident possible?
From the steam related accidents within the last 2 years at Hanford, death can result from a steam/water hammer event.

How likely is the worst accident to occur?
Given the PUREX systems, death from hammer is not considered likely, however, serious injury is considered credible.

How much damage is done?
Facility damage from a hammer incident would likely be limited to the system.

How much material is released?
Steam would be released, possibly in sufficient quantities to cause serious burns to nearby personnel.

Can the operator(s)/worker(s) be contaminated (to a greater extent than outer protective wear contamination)?
Contamination is not a factor in this procedure.

Can the operator(s)/worker(s) be injured?
Yes, the entire range of injuries from minor to death can result from hammer related incidents.

Can the operator(s)/worker(s) be killed?
Yes, there has been one death related to steam hammer within the last 2 years at Hanford.

What is the most likely accident to occur that can injure an operator/worker?
The introduction of steam to a system containing water will result in a hammer effect. This can lead to the rupture of the system lines and personnel being burned by the steam.

Do you recommend a more systematic and thorough determination of "What can go wrong?", "What are the consequences?", and "How likely is it?"?
Yes, a JSA would be an appropriate means to evaluate the current procedure to determine if the proper controls are in place to prevent hammer type incidents and prevent injury to the workers.

Does the completion of this work activity place extra or unusual demands on systems, programs or personnel?

No, this is a routine facility activity.

Cognizant Engineer________________________ Date_______
Safety Analyst_____________________________ Date_______

Preliminary Hazard Screening Assessment (PHSA). (part 2 of 2).

Appendix C: PUREX USQ Screening Form

PUREX USQ Screening Form

Originator____________________
Reference Item #:______________
Title:____

INTRODUCTION

1. Summarize the issue
2. Identify the operating parameters and systems affected by the issue.
3. Identify the bounding accident(s)/condition(s) for this issue.

SCREENING

1. Does/did the issue increase any of the following, as described explicitly or implicitly in the authorization basis?

Hazards Inventory	No_	Yes/Maybe_	N/A_
Isotopic Distribution (Change)	No_	Yes/Maybe_	N/A_
Chemical reactivity	No_	Yes/Maybe_	N/A_

2. Does/did the issue change/exceed any bounding conditions or assumptions used in the prevention of criticality or control of other hazardous materials?

   No_ Yes/Maybe_ N/A_

3. Does/did the issue impact, either directly or through system interactions, any systems identified in the authorization basis as mitigating or preventing accidents?

   No_ Yes/Maybe_ N/A_

4. Does/did the issue introduce the potential for a new accident/hazard not previously analyzed or bounded by those identified in the authorization basis documents?

   No_ Yes/Maybe_ N/A_

5. Does/did the issue change (add, delete or modify) any OSRs/TSRs and related safety limits or LCOs including margins of safety?

   No_ Yes/Maybe_ N/A_

6. Does/did the issue involve any experiments or tests not described in the authorization basis?

   No_ Yes/Maybe_ N/A_

7. Does/did the issue increase the number of times an activity is performed to a level greater than for routine or normal facility operations?

   No_ Yes/Maybe_ N/A_

Unreviewed Safety Question Evaluator #1 ________	DATE _____	Agree_	Disagree_
Unreviewed Safety Question Evaluator #2 ________	DATE _____	Agree_	Disagree

Provide justification for the response to each question. Attach extra pages as necessary.

USQ Screening Form.

Appendix D: References

1. DOE-EM-STD-5502, Hazard Baseline Documentation
2. DOE-EM-STD-5503, Health and Safety Plan Guidelines
3. DOE-STD-1027-92, Hazard Characterization and Accident Analysis Techniques for Compliance with DOE 5480.23
4. PUREX/UO_3 Facilities Deactivation Lessons Learned History
5. PUREX/UO_3 Deactivation Project Management Plan (PMP)
6. DOE-STD-5480.22, Technical Safety Requirements
7. DOE 5480.23, Nuclear Safety Analysis Reports
8. DOE-STD-3011-94, Guidance for Preparation of 5480.22 (TSR) and 5480.23 (SAR) Implementation Plans
9. OSHA 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER)
10. DOE Order 5480.21, Unreviewed Safety Questions(USQ)
11. DOE-STD-3009, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports
12. DOE/EH-0478, Handbook for Occupational Safety and Health During Hazardous Waste Operation
13. DOE/EH-0479, Working Safely During DOE Hazardous Waste Activities
14. DOE/EH-0480, Management Perspectives on Worker Protection During Hazardous Waste Activities